USDA
FOREST SERVICE
RESEARCH
PAPER NC-77
1972

CANOEIST SUGGESTIONS for STREAM MANAGEMENT In the MANISTEE NATIONAL FOREST of MICHIGAN

MICHAEL J. SOLOMON
EDWARD A. HANSEN

NORTH CENTRAL FOREST EXPERIMENT STATION
FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

North Central Forest Experiment Station
John H. Ohman, Director
Forest Service — U.S. Department of Agriculture
Folwell Avenue
St. Paul, Minnesota 55101
(Maintained in cooperation with the University of Minnesota)

Manuscript approved for publication March 14, 1972.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

CONTENTS

Page

Summary 1

The Study Area 1

Methods 2

Results 3

Management Implications 9

Literature Cited 10

THE AUTHORS: Michael J. Solomon, Hydrologist, is with the USDA Forest Service at the Huron-Manistee National Forest headquarters in Cadillac, Michigan. Edward A. Hansen, Hydrologist for the North Central Forest Experiment Station, is located at Cadillac, Michigan. **The authors gratefully acknowledge the guidance in study design given by Dr. David W. Lime and the many long hours devoted to data collection and analysis by Ruth Bosworth, James Zillmer, and Harry Richards.**

CANOEIST SUGGESTIONS FOR STREAM MANAGEMENT IN THE MANISTEE NATIONAL FOREST OF MICHIGAN

Michael J. Solomon and Edward A. Hansen

SUMMARY

Canoeing in northern Lower Michigan has increased greatly during the last decade, resulting in littering, crowding, and degradation of rivers and riverbanks. A survey was undertaken to determine canoeists' opinions concerning their experiences on the Pine River. These opinions permit the listing of management priorities from the canoeist's standpoint.

An important part of this survey was to determine the canoeists' attitudes toward eroding streambanks. The Pine River is only one of many streams with severe streambank erosion. In the past, streambanks have been stabilized in Michigan primarily to improve fish habitat. Now, however, bank stabilization for fish habitat improvement is being contemplated for some streams, such as the lower portion of the Pine River, where canoeing is the major use. In such cases, the canoeists' attitudes toward eroding streambanks should play a large role in deciding whether or not to stabilize the banks.

About 50,000 persons canoed the Pine River during 1971. Most canoeists enjoyed their trip, particularly the rapids and the wild, natural appearance of the stream and its shoreline. The primary objections concerned littering and crowding. Comments that involve stream management can be summarized as "leave the stream natural with little or no development" and "clean up the litter." Canoeists were unconcerned about eroding streambanks and about a dam they had to portage around.

THE STUDY AREA

The Pine River flows through the Manistee National Forest in the northwest part of the Lower Peninsula of Michigan. It is within a few hours drive of all the large cities in southern Michigan and is less than a day's drive from metropolitan areas such as Chicago, Gary, Columbus, and Toledo. It is readily accessible to about 10 percent of the nation's population for weekend canoeing and camping trips.

The Pine is 60 miles long; the lower 40 miles are canoeable. There are eight primary canoe access points (fig. 1). Five local canoe liveries service the Pine River and additional canoes are occasionally brought from more distant liveries. Maximum float time is 13 hours (Edgetts to Low Bridge); thus, most of the River can be seen in 1 day, though this is seldom done. The Pine River has 204 eroding banks along the lower 26 miles (Hansen 1971), ranging up to 1,000 feet in length and 100 feet in height. Two-thirds of the shoreline is presently owned by either the State of Michigan or by a public utility. Much shoreline is also privately owned along the upper end of the canoeable portion of the stream, but almost none along the lower end. Along the shoreline are one Federal and one State campground.

The Pine is as undeveloped as any river in Michigan's Lower Peninsula. In the canoeable portion (Edgetts to Low Bridge), there are less than 50 cabins, many of which are rustic or not easily seen from the stream. The only other obvious intrusions by man are eight bridges and Stronach Dam, a small abandoned hydroelectric dam.

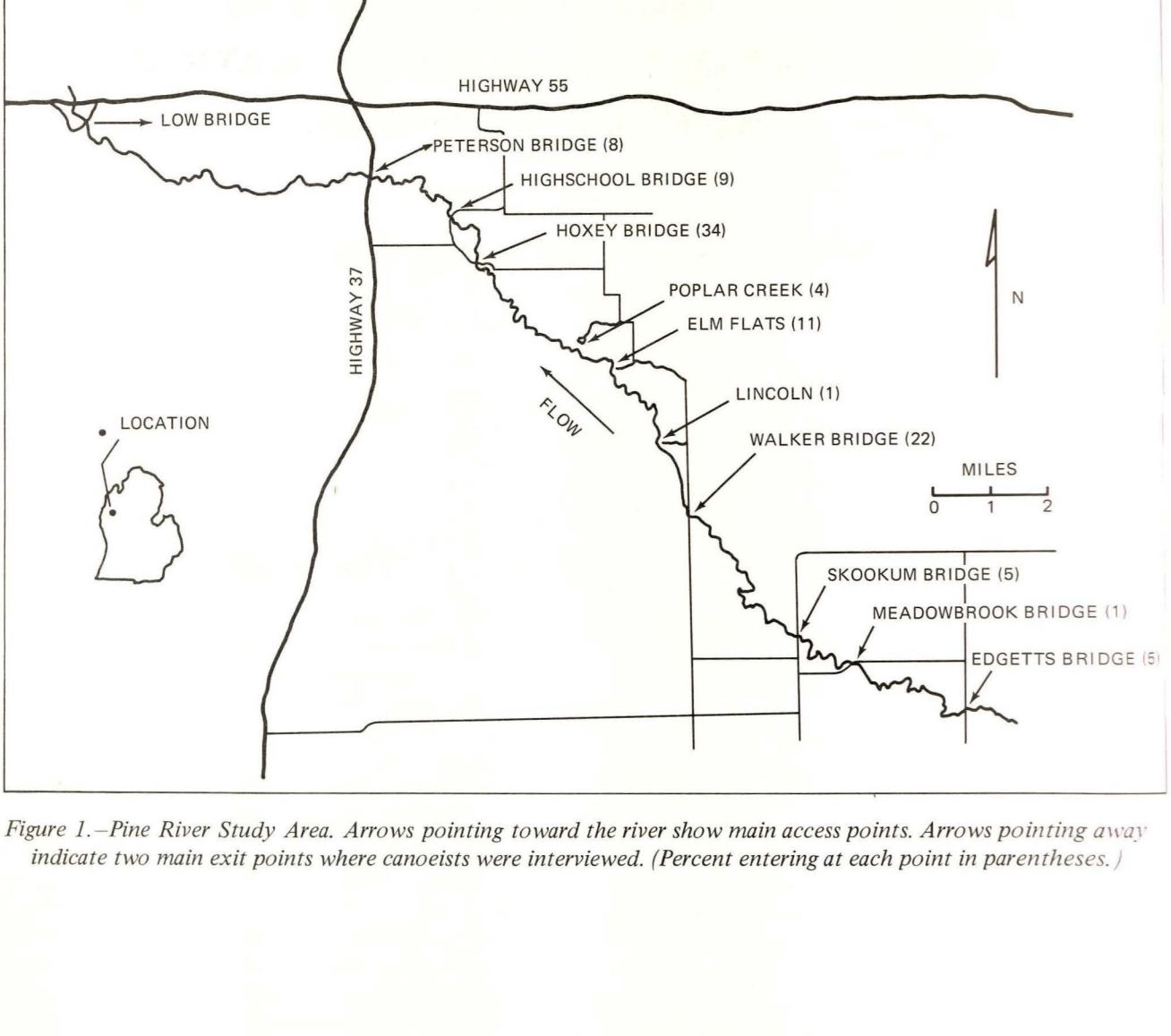


Figure 1.–Pine River Study Area. Arrows pointing toward the river show main access points. Arrows pointing away indicate two main exit points where canoeists were interviewed. (Percent entering at each point in parentheses.)

METHODS

The study was conducted from May 20, 1971, through September 30, 1971. Most of the canoeing on the Pine is done between these dates. Five weekday and 5 weekend days were randomly selected from this period. Two dates that fell on holidays were treated as "weekend" dates, because no consistent difference between weekend and holiday responses was detected.

Peterson Bridge and Low Bridge were selected as the two access sites at which to conduct the interview (fig. 1). All canoeists over 15 years of age exiting between the hours of noon and 8:00 p.m. were interviewed on the selected dates.

Most of the questionnaire was structured so that the respondents could simply check appropriate replies. However, the section dealing with the canoeist's impressions of the canoe trip ("high" and "low" points of the trip, and "suggested improvements") was left "open-ended" so that respondents could write in whatever occurred to them. The responses thus obtained were presumably spontaneous.

The weekday samples provided reliable data on the total number of canoeists exiting from the two access points. Weekend data, however, had population estimate errors that increased as canoeist numbers increased. When large numbers of canoeists exited, some canoeists (particularly "underage" canoeists) were accidently missed, resulting in a low estimate of

canoeist numbers. A second attempt to obtain total canoeist numbers at an exit point by grouping the questionnaires by party size and then summing the party-size information for all parties resulted in a consistent overestimate of canoeist numbers. An independent count on one of the weekend sample dates indicated that the actual total number of canoeists was close to the mean of the estimates obtained by the above two approaches. Therefore, the average of the two estimates was used for the other four weekend sample dates.

The annual number of canoeists was estimated by calculating the average number of weekend and weekday rental canoes for the 10 sample dates from data supplied by local outfitters. The averages were expanded to account for private and organization canoes (11 percent weekends and 31 percent weekdays) and a canoeist per canoe factor of 2.1; they were then applied to the canoeing season of May 1 to September 30. This procedure overestimates canoe usage during May and September but does not account for canoeists in April and October.

Because the majority of interviews were conducted on weekends (93 percent), "total sample" and "weekend" statistics are nearly the same and are not separated in the text. Weekday statistics are presented separately only when they depart markedly from the weekend data.

RESULTS

Canoeist Characteristics

Twenty percent of the canoeists came from the Detroit area and 28 percent from the Grand Rapids-Muskegon area (fig. 2). About 14 percent were from out-of-State, primarily from bordering metropolitan

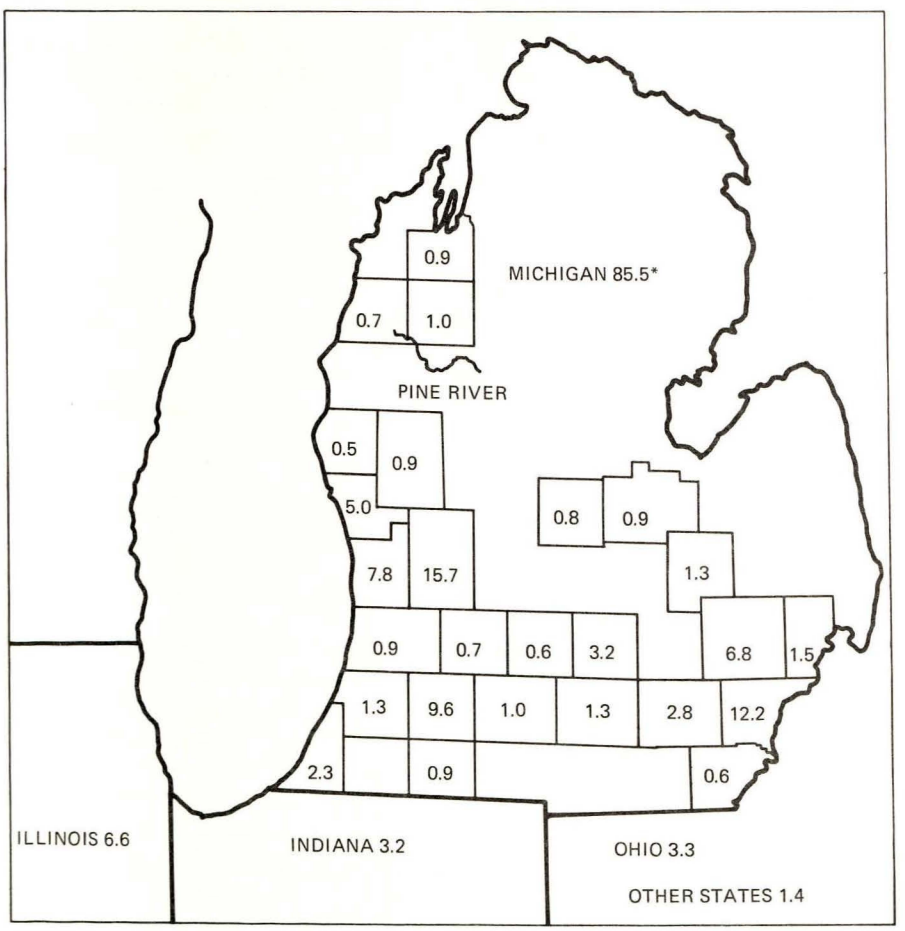


Figure 2.—Origin of canoeists (in percent). The asterisk indicates counties with less than 0.5 percent not shown.

areas in Illinois, Indiana, and Ohio. Almost no visitors came from the north, as was also noted in a study of Manistee National Forest campers (King 1965).

The total number of respondents for the 10 sample days was 2,676. Weekday and weekend respondents numbered 193 and 2,483 respectively (table 1). There was an average of 82 canoeists per day on weekdays and 911 canoeists per day on weekends. Total number of canoeists for the 1971 season was estimated to be 50,000.

Party size varied from 1 to 120. Approximately 40 percent of the canoeists traveled in groups of less than 10, 30 percent in groups of 10 to 19, and 30 percent in groups of 20 to 100. Eighty-eight percent of the users canoed with two people in a canoe and 10 percent were three to a canoe. The average was 2.1 people per canoe.

Two-thirds of the canoeists interviewed left from three of the 10 launch areas (see parenthetical data in figure 1). Hoxey Bridge was the major entry point, with about 50 percent of the weekday use and 34 percent of the weekend use. Walker Bridge was the second most heavily used access point, with 22 percent of the traffic. Use of the upstream launch areas is possibly greater than indicated in figure 1 because some of these canoeists may exit before reaching the two exit points sampled in this survey. The magnitude of this bias is believed to be small.

Approximately 60 percent of the canoe trips were for a single day or less. One-third were 2-day trips and 7 percent were 3-day trips. However, in addition, nearly half of the canoeists were camping either before or after their canoe trip.

Almost two-thirds of those interviewed were making their first trip down the Pine. Only 12 percent had visited it more than 4 years. Eighteen percent of the canoeists made more than one visit to the Pine River during this summer.

Eighty-nine percent of the canoes were rental, 10 percent were private, and 1 percent belonged to camps. Weekdays showed many more canoes from organized camps (22 percent) and fewer private (9 percent) than weekends. Students were the largest user group, comprising 27 percent of the sample, followed by professionals with 23 percent. When only weekdays were considered, 65 percent were students and 12 percent were professionals.

Table 1.—Total sample size

Date (1971)	Canoeists interviewed	Estimated total exiting
Weekdays:		
May 26 (Wed.)	4	4
June 25 (Fri.)	34	57
June 28 (Mon.)	45	62
July 20 (Tues.)	67	110
August 10 (Tues.)	43	103
Total weekday	193	336
Holidays and weekends:		
May 31 (Mon.)	292	1/ 350 (± 58)
June 5 (Sat.)	438	611 (±173)
July 25 (Sun.)	524	625 (±100)
August 21 (Sat.)	669	851 (±182)
September 5 (Sun.)	560	2/ 662 (±102)
Total weekend	2,483	3,099
Total all days	2,676	3,435

1/ Upper value based on party-size data and lower value on number of completed questionnaires.
2/ Independent count tallied 657.

Most of the Pine River users were young: half were in the 16 to 24 age bracket and on weekdays three-fourths were in this category. In addition, many canoeists were less than 16 years old and were not interviewed. Only 11 percent were 40 years of age or older. Thirty-nine percent of the population was female.

Half of those polled had some college education. Eleven percent had 4 years of college education and an additional 16 percent had some postgraduate work. Only 4 percent of all canoeists over 19 years of age had less than a high school education.

Canoeist Attitudes

Response was excellent; less than 2 percent of the canoeists refused to fill out the questionnaire. Eighty-eight percent made some comment for at least one of the write-in questions about the "high" or "low" points of the trip, or "suggested improvements." These responses constituted the most valuable portion of the study. Of those that didn't answer the write-in questions, 6 percent did not have any strong impressions pro or con about their trip and indicated so by writing "none," and 6 percent accidently or intentionally did not complete the questionnaire.

Trip Purpose

Respondents were requested to check all "purposes" that applied to their canoe trip. The results are tabulated below:

	Canoeists interviewed Percent
Things to do:	
Canoe	96
Camp	45
Sight-see	27
Swim	25
Picnic	18
Photography	5
Fish	4
Hike	3
Getting away from it all:	
Relaxation	53
Away from civilization	49
Commune with nature	27
Solitude	19

There is an important difference between the above two groups. Whereas many of the items in the first group imply some development — i.e., campgrounds, picnic areas, waste disposal facilities, canoe launching sites, parking areas, etc. — the last three items in the second group imply little or no development. Many people indicated "purposes" from both groups, thus presenting a dilemma to recreation resource managers to try to strike an acceptable compromise between "develop" and "leave natural."

Almost 20 percent of the users indicated solitude as a purpose for their trip. It appears that "solitude" is essentially a state of mind, because on weekends the canoeist shares the river with nearly a thousand other users. Party size did not seem to affect this state of mind either. Sixteen percent of those traveling in groups of 40 or larger were still seeking solitude as a trip purpose.

Trip High Points

Most canoeists were well satisfied with their canoe trip and many listed several high points. Comments under "high points" outnumbered those under "low points" and "suggested improvements" by a ratio of 2 to 1 (table 2). The most commonly stated high points of the trip were factors associated with the stream and its "wilderness" surroundings. Half of the respondents indicated rapids or scenery as the high point of their trip; fewer indicated such associated factors as nature (7 percent) and solitude (5 percent). This high satisfaction with the overall stream environment probably accounts for the lack of such items under "low points," with the minor exception of the 4 percent of the respondents who would like "even more rapids."

Other high points frequently stated concerned the canoe trip itself; i.e., camping (11 percent), tipping over (8 percent), companionship (7 percent), and swimming (5 percent).

Low Points and Suggested Improvements

These two categories are discussed together because the replies are similar for both. Generally, when a respondent listed a "low point" he also suggested ways to improve it. Exceptions are low points such as "insects," "not enough rapids," and "tipping over," which are essentially nonmanageable.

Table 2.—Canoeists' attitudes toward their trip

High point mentioned [1]	Canoeists interviewed	Low point mentioned [1]	Canoeists interviewed	Improvement suggested [1]	Canoeists interviewed
	Percent		Percent		Percent
Rapids	34	Litter	16	Clean up litter	24
Scenery	24	Too many people	9	Leave natural	21
Camping	11	Obstructions to canoeing	7	Remove canoeing obstructions	11
Tipping over	8	Rowdy or drunk canoeists	5	More intermediate facilities	5
Companionship	7	Not enough rapids	4	More campsites	2
Nature	7	Insects	3	Limit private development	2
Solitude	5	Too few or poor campgrounds	3	Control erosion	1
Swimming	5	Intermediate facilities	3	More sand beaches	1
Clean, cold water	5	Tipping over	2	Limit canoes	1
Narrowed stream	2/5	Stronach Dam	2/1	Remove Stronach Dam	2/1
Eroding banks	4	No reply	47	No reply	35
Obstructions	4				
Watching other canoeists	2				
Stronach Dam	2/2				
No reply	26				
Total comments [3]	118		53		68

[1] All items mentioned by 2 percent or more of the canoeists are shown. Only selected items are shown that had less than 2 percent response.

[2] Based only on responses from canoeists who passed these features.

[3] Some respondents listed several items under "high points," "low points," or "improvements."

The satisfaction of canoeists showed up again in the answers given to the question "How do you feel the Pine River and its shoreline could be improved?" (table 2). Twenty-one percent of the canoeists stated "leave it natural" or "perfect as is." an additional 35 percent gave no reply, and it seems reasonable to assume that many of these were also satisfied with the stream in its present condition.

The most frequent complaint was about litter. Sixteen percent of the respondents listed it as a low point and 24 percent stated that it should be cleaned up. A total of 31 percent of the respondents made some comment about litter.

The second most frequently stated low point was "too many people" (fig. 3). A 1962 study that was made before the rapid increase in canoeing on the Pine River found few complaints about "too many people" canoeing (Lucas 1970). However, that study was based on campers in general and was not restricted to canoeists.

It is significant that almost all of the complaints made during this study were on weekends or holidays when crowding was most evident. Almost no complaints were made on weekdays. On weekends when 300 or more people exited at the two sample points, about 9 percent objected to crowding. It seems valid to hypothesize that as total numbers increase, the proportion objecting to "crowding" would increase also. However, there was no increased dissatisfaction expressed as canoeist numbers increased from 300 to 700. Nor was the percent of canoeists that complained about crowding related to exit point. Either total number of canoeists exiting from a stream is not a sensitive indicator of crowding at high-use intensities, or possibly people who dislike crowding tend to stay away as crowding increases.

Canoeists in small parties objected most to crowding. In parties of 20 or more (10+ canoes), the major contact is with other members of the same party, which apparently is not objectionable; or possibly, people in large parties are more tolerant of or even desire large numbers of people.

Figure 3.—"Too many people" was the second most frequently expressed objection.

Party size	*Objecting to too many people Percent*
1- 5	11.7
6- 9	7.9
10-19	10.8
20-29	5.2
30-39	5.5
40-49	1.5
50+	3.7

Another complaint related to crowding concerned "rowdy and/or drunk" canoeists. Complaints of rowdyism increased disproportionately as use increased. No solutions to the crowding problem were suggested under improvements except for a small number of respondents (1 percent) who suggested regulating the number of canoes.

The third most frequently stated "low point" was "obstructions to canoeing" (table 2). Although a few canoeists wanted a general cleanup of logs and debris in the stream, a larger number specifically stated removal of only a few log jams and trees that completely blocked the stream. For example, one large log jam 2 miles above the downstream exit point is the largest on the stream, and 70 percent of the complaints about obstructions were made at that exit. Selective removal of obstructions at only a few points in the stream would probably eliminate most of the complaints about such items. Any substantial removal of obstructions might begin to detract from the enjoyment of the group who list "obstructions" as a high point of their trip.

About 6 percent of the respondents expressed disappointment at the lack or poor quality of campgrounds and other facilities along the stream (table 2). About the same number requested under "suggested improvements" that more facilities (toilets,

picnic sites, drinking water, signs, campsites, etc.) be constructed (table 2). There were slightly more requests for more facilities from campers (5 percent) than noncampers (3 percent), a trait noted by Lucas (1970). Also, 97 percent of the requests for more facilities came on weekends.

The response "leave natural" does not necessarily mean "no development." Two percent of those stating "leave natural" advocated more facilities, as opposed to 7 percent for all canoeists. On the other hand, only 1 percent of the "leave natural" group desired removal of obstructions, compared with 14 percent of all canoeists. Both groups held the same attitudes toward litter.

Stronach Dam, which requires a portage, is situated three-fourths of a mile above the lower exit point. Only 1 percent of the canoeists listed removal of Stronach Dam as a suggested improvement whereas 2 percent of the canoeists listed the dam as a "high point." In addition, a larger group (5 percent) listed as a "high point" a narrowed abraided section on reservoir fill above Stronach Dam that would be destroyed by dam removal. Thus, it appears that canoeist opinion does not presently call for removal of Stronach Dam.

Only 1 percent of the respondents requested stabilization of eroding banks (fig. 4). In contrast, about 4 percent of the respondents listed eroding banks as a high point of their trip (table 2). The typical response was that they "liked to run and slide down the steep sand banks" or the "cliffs looked impressive." However, in general there was little comment pro or con on the esthetics of the banks. Less than 1 percent ob-

Figure 4.—As many canoeists liked the dramatic "cliffs" as objected to streambank erosion.

jected to "muddy water," a condition to which bank erosion contributes, whereas 5 percent were impressed by the "clean, cold water."

The lack of comment on eroding streambanks, together with the high satisfaction expressed for the "scenery" and the emphasis on "leave natural," leads to the conclusion that the eroding banks are accepted as part of the natural environment by canoeists.

MANAGEMENT IMPLICATIONS

A wide range of attitudes were evidenced by canoeist responses in this study. Often what is liked by part of the group is disliked by others in the same group. This constitutes a management dilemma; i.e., how much management should be undertaken, whose desires should be met, and how should priorities be established? This study cannot give final answers to these questions. Other important factors need to be considered also, such as the maximum number of canoeists that can use the stream without serious environmental degradation, the attitudes of other users who do not canoe, and the way in which the recreation resource of the stream fits in with that of nearby streams.

Management alternatives will be discussed within a "complementary-antagonistic" framework. Items in the complementary category can be managed without much conflict between canoeists. However, the items categorized as "antagonistic" present varying degrees of difficulty for management planning. Canoeists expressed opinions about these items that were mutually exclusive. Some can probably be resolved through judicious compromise but others will require an either/or decision.

Complementary Management Options

Canoeists strongly indicated their desire to maintain the natural environment through such comments as "perfect as is," "halt private development," and "you can't improve on nature." No one complained about lack of commercialization. Consequently, a management plan to keep the stream environment "natural" would meet with general approval.

Many, if not most, canoeists would be in favor of a litter reduction program of some type. Several things could be done to reduce the litter problem. For example, more refuse containers with better spacing and more frequent servicing could be provided. It could be required that all material carried in the canoe be either secured or in a floatable container, thus preventing loss when the canoe tips. Cans, bottles, and other nonburnable containers could be banned.

Antagonistic Management Options

The comment "too many people" was given within the context of "too many other canoeists." However, from a management standpoint "too many people" must also be considered in relation to the maximum number the environment can tolerate before serious degradation occurs, and to the seriousness of conflicts between different user groups (fishermen versus canoeists, or canoeists out for a group outing versus canoeists seeking solitude).

Regulation of canoe numbers presents a dilemma. Although no canoeists liked the crowding and many complained about it, presumably no one would willingly stay away to reduce the crowding problem. thus, any regulation of canoeist numbers is antagonistic because it will benefit some canoeists to the detriment of others (those eliminated). On the other hand, lack of regulation would probably result in a continued increase of canoeist numbers to the detriment of those who object to "crowding" and those who are seeking "solitude." Increased canoeist numbers would also tend to compound problems such as "not enough campgrounds and other facilities," "litter," and "degradation of the shoreline," while reduced canoeist numbers would tend to lessen the severity of these problems.

This study does not define the optimum level of use. However, it does provide a clue in that although canoeists were generally satisfied with their trip, a substantial portion of weekend canoeists already object to crowding, and another fraction wants more facilities of all types, which would in turn detract from the widely heralded "naturalness" of the area. Thus, it seems reasonable to say that weekend canoeist numbers (an estimated 900+ people per day) are somewhere near the level the Pine River can handle and still satisfy the diversified desires of the canoeists. Any management efforts to reduce canoeist impact on the shoreline (e.g., prohibiting landing at ecologically unstable areas of the shore), reduce litter, construct off-stream facilities effectively screened from the

canoeist view, or reduce canoeist numbers during peak hours by more even distribution during the day would tend to permit greater numbers of canoeists to use the stream. Or, given a fixed number of canoeists, the quality of the canoeing experience would be increased.

Although many canoeists requested more facilities (such as campgrounds, picnic sites, and toilets), construction of such facilities without some type of ceiling on user numbers might encourage even more crowding. This added crowding might result in even lower quality facilities or fewer facilities when expressed on a per-canoeist basis. Also, additional canoeist numbers would be antagonistic to other desirable assets such as "solitude" and the "naturalness of the stream." Thus, the following recommendation for added facilities is within the context of more facilities per canoeist together with the assumption that other desirable attributes of the canoeing experience would not suffer.

Better distributed and more intimate camping facilities are needed. Campgrounds could be developed to provide facilities only for canoeists. Better intermediate facilities are also needed. These could be developed at camping areas, entrance points, and selected intermediate points along the stream to provide adequate sanitary facilities, drinking water, and refuse containers. Disturbance to the natural shoreline should be minimized. Better access facilities could also be provided at selected points.

A few key obstructions could probably be removed with little detriment to the "challenge of obstructions" noted under "high points." Wide-scale removal of obstructions should be avoided, however. Also, there appears to be little justification for dam removal.

Streambank erosion was viewed as a problem by only a few canoeists, and the banks were not considered to be esthetically detracting. In fact, more canoeists liked the eroding banks than disliked them. Therefore, streambank stabilization on the Pine River should be done only if clearly dictated by factors other than canoeing.

LITERATURE CITED

Hansen, Edward A. 1971. Sediment in a Michigan trout stream; its source, movement, and some effects on fish habitat. USDA For. Serv. Res. Pap. NC-59, 14 p. North Cent. For. Exp. Stn., St. Paul, Minn.

King, David A. 1965. Characteristics of family campers using the Huron-Manistee National Forests. USDA For. Serv. Res. Pap. LS-19, 11 p. Lake States For. Exp. Stn., St. Paul, Minn.

Lucas, Robert C. 1970. User evaluation of campgrounds on two Michigan National Forests. USDA For. Serv. Res. Pap. NC-44, 15 p. North Cent. For. Exp. Stn., St. Paul, Minn.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1972—760-830

SOME RECENT RESEARCH PAPERS OF THE NORTH CENTRAL FOREST EXPERIMENT STATION

Site Index Curves for Black, White, Scarlet, and Chestnut Oaks in the Central States, by Willard H. Carmean. USDA For. Serv. Res. Pap. NC-62, 8 p., illus. 1971.

Wilderness Ecology: Virgin Plant Communities of the Boundary Waters Canoe Area, by Lewis F. Ohmann and Robert R. Ream. USDA For. Serv. Res. Pap. NC-63, 55 p., illus. 1971.

Management Guide for the Black Spruce Type in the Lake States, by William F. Johnston. USDA For. Serv. Res. Pap. NC-64, 12 p., illus. 1971.

Site-Index Comparisons for Tree Species in Northern Minnesota, by Willard H. Carmean and Alexander Vasilevsky. USDA For. Serv. Res. Pap. NC-65, 8 p., illus. 1971.

The Effects of Soil Moisture, Texture, and Nutrient Levels on the Growth of Black Walnut, by Richard E. Dickson. USDA For. Serv. Res. Pap. NC-66, 6 p., illus. 1971.

Research at the Institute of Forest Genetics, Rhinelander, Wisconsin, by Richard M. Jeffers. USDA For. Serv. Res. Pap. NC-67, 31 p., illus. 1971.

Crosscut Shearing of Roundwood Bolts, by Rodger A. Arola. USDA For. Serv. Res. Pap. NC-68, 21 p., illus. 1971.

Storm Flow from Dual-Use Watersheds in Southwestern Wisconsin, by Richard S. Sartz. USDA For. Serv. Res. Pap. NC-69, 7 p., illus. 1971.

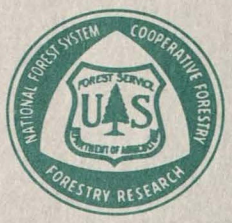
Annotated Bibliography of Walnut—Supplement No. 1, by Martha K. Dillow and Norman L. Hawker. USDA For. Serv. Res. Pap. NC-70, 23 p. 1971.

Fire Whirlwind Formation Over Flat Terrain, by Donald A. Haines and Gerald H. Updike. USDA For. Serv. Res. Pap. NC-71, 12 p., illus. 1971.

The Changing Hardwood Veneer and Plywood Industry of Michigan and Wisconsin, by Gary R. Lindell and Lewis T. Hendricks. USDA For. Serv. Res. Pap. NC-72, 8 p., illus.

ABOUT THE FOREST SERVICE . . .

As our Nation grows, people expect and need more from their forests — more wood; more water, fish, and wildlife; more recreation and natural beauty; more special forest products and forage. The Forest Service of the U.S. Department of Agriculture helps to fulfill these expectations and needs through three major activities:



- Conducting forest and range research at over 75 locations ranging from Puerto Rico to Alaska to Hawaii.
- Participating with all State forestry agencies in cooperative programs to protect, improve, and wisely use our Country's 395 million acres of State, local, and private forest lands.
- Managing and protecting the 187-million acre National Forest System.

The Forest Service does this by encouraging use of the new knowledge that research scientists develop; by setting an example in managing, under sustained yield, the National Forests and Grasslands for multiple use purposes; and by cooperating with all States and with private citizens in their efforts to achieve better management, protection, and use of forest resources.

Traditionally, Forest Service people have been active members of the communities and towns in which they live and work. They strive to secure for all, continuous benefits from the Country's forest resources.

For more than 60 years, the Forest Service has been serving the Nation as a leading natural resource conservation agency.